

CLAIMS

1. An emitter for incandescent light sources, capable of being brought to incandescence by means of the passage of electric current, wherein on at least one surface of the emitter (F) a micro-structure (R) is provided, operative to enhance absorbance for wavelengths belonging to the visible region of the spectrum, characterized in that

10 - said micro-structure (R) is at least partly formed with a material (W; Au; W, Au) whose melting temperature is lower than an operating temperature of the emitter (F), and

15 - at least a substantial portion of the emitter (F), including said micro-structure (R), is coated with a refractory oxide (OR) or an oxide with high melting temperature,

said oxide (OR) being operative to preserve a profile of said micro-structure (R) in case of deformation or change of state of the respective material (W; Au; W, Au), consequent to the use of the emitter (F) at operating temperatures exceeding the melting temperature of said material (W; Au; W, Au).

2. An emitter as claimed in claim 1, characterised in that said oxide (OR) is operative to preserve a profile of said microstructure (R) also from effects of evaporation of the respective material (W; Au; W, Au) at high operating temperature.

3. An emitter as claimed in claim 1, characterised in that the emitter (F) is almost completely coated by said oxide (OR), in particular with the exception of respective areas for connection to terminals (H).

4. An emitter as claimed in claim 1, characterised in that said micro-structure (R) is made of a conductor, semiconductor or composite material (W; Au; W; Au), whose optical constants, combined with the

shape of the micro-structure (R), are such as to allow a higher luminous emission efficiency than a classic incandescence filament, said efficiency being defined as the ratio between the fraction of visible radiation emitted at the operating temperature in the interval 380 nm - 780 nm and the fraction of radiation emitted at the same temperature in the interval 380 nm - 2300 nm.

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10 5. An emitter as claimed in claim 1, characterised in that said material (Au) is selected among conductor, semiconductor and composite materials whose melting temperature is lower than the operating temperature of the filament (F).

15 6. An emitter as claimed in claim 1, characterised in that it is formed by at least a first layer of conductor material (W), melting at higher temperature than the operating temperature of the emitter (F), such as tungsten, and by a second layer of material (Au) selected among conductor, semiconductor and composite materials whose melting temperature is lower than the operating temperature of the emitter (F).

20 7. Emitter as claimed in claim 1, characterised in that said micro-structure (R) is at least partly formed with a material selected among gold, silver and copper.

25 8. Emitter as claimed in claim 1, characterised in that said oxide (OR) is selected among ceramic base oxides, thorium, cerium, yttrium, aluminium or zirconium oxide.

30 9. An emitter as claimed in claim 1, characterised in that said micro-structure (R) is obtained by means of a superficial micro-structure of the emitter (F), i.e. in the same material which constitutes the emitter (F).

35 10. An emitter as claimed in claim 1, characterised in that said micro-structure comprises a diffraction

grating (R), having at least one of a plurality of micro-projections (R1, R2) and a plurality of micro-cavities (C), where the dimensions (h, D) of the micro-projections (R1, R2) or of the micro-cavities (C) and the period (P) of the grating (R) are such as to

- enhance the emission of visible electromagnetic radiation from the material (W; Au; W, Au) constituting at least the micro-structure (R), and/or
- reduce the emission of infrared electromagnetic radiation from the material (W; Au; W, Au) constituting at least the micro-structure (R), and/or
- enhance the emission of the infrared electromagnetic radiation from the material (W; Au; W, Au) constituting at least the micro-structure to a lesser extent with respect to the increase in visible emissivity.

11. An emitter as claimed in claim 10, characterised in that said grating (R) is obtained with

- a first conductor material (W) melting at higher temperature than the operating temperature of the emitter (F), the first material having a structured part,
- a coating layer (Au) which covers at least the structured part of said first material (W), the coating layer being of a second material (Au) selected among conductor, semiconductor or composite materials melting at lower temperature than the operating temperature of the emitter (F),

where the coating layer (Au) is sufficiently thin to copy the profile of the structured part of the first material (W), to form therewith said grating (R), and the second material (Au) has a greater emission efficiency than the first material (W), said efficiency being defined as the ratio between the fraction of visible radiation emitted at the operating temperature

in the interval 380 nm - 780 nm and the fraction of radiation emitted at the same temperature in the interval 780 nm - 2300 nm.

12. An emitter as claimed in claim 10,  
5 characterised in that

- said grating (R) is obtained on the surface of a layer (Au) of a first conductor, semiconductor or composite material whose melting temperature is lower than the operating temperature of the filament (F),

10 - said layer (Au) is placed on a second conductor material (W) whose melting temperature is higher than the operating temperature of the emitter (F),

where the first material (Au) has higher emission efficiency than the second material (W), said  
15 efficiency being defined as the ratio between the fraction of visible radiation emitted at the operating temperature in the interval 380 nm - 780 nm and the fraction of radiation emitted at the same temperature in the interval 380 nm - 2300 nm.

20 13. An emitter as claimed in claim 10, characterised in that said grating (R) is obtained with

- a layer of said oxide (OR), having a structured part,

25 - a coating layer (Au) which covers at least the structured part of the said layer of oxide (OR), the coating layer being of a material (Au) selected among conductor, semiconductor or composite materials melting at lower temperature than the operating temperature of the emitter (F),

30 where the coating layer (Au) is sufficiently thin to copy the profile of the structured part of said layer of oxide (OR), to form therewith said grating (R), and where the coating layer (Au) is in turn coated by an encapsulating layer constituted with said oxide  
35 (OR).

14. An emitter as claimed in claim 3, characterised in that at least a throat or cavity (G) is provided, open on the material constituting the emitter (F) and defined in at least one among said electrodes (H) and said oxide (OR), the cavity or cavities (F) provided being operative to receive part of said material as a result of volume expansions thereof and/or to avoid delamination phenomena between said oxide (OR) and said material and/or ruptures of the complex constituted by said material, said oxide (OR) and said electrodes (H).

15. An emitter as claimed in claim 10, characterised in that the periodicity of the micro-projections (R1, R2) or of the micro-cavities (C) is of the order of the wavelength of visible radiation.

16. An emitter as claimed in claim 10, characterised in that the periodicity of the micro-projections (R1, R2) or of the micro-cavities (C) is between 0.2 and 1 micron.

17. An emitter as claimed in claim 10, characterised in that the height or depth of the micro-projections (R1, R2) or of the micro-cavities (C) is between 0.2 and 1 micron.

18. An emitter as claimed in claim 1, characterised in that said micro-structure (R) is binary, i.e. with two levels.

19. An emitter as claimed in claim 1, characterised in that said micro-structure (R) is multi-level, i.e. it has a projection with more than two levels.

20. An emitter as claimed in claim 1, characterised in that said micro-structure (R) has a continuous projection.

21. An emitter as claimed in claim 1, characterised in that it operates at a lower temperature than the melting temperature of said oxide (OR).

22. An emitter as claimed in claim 1, characterised

in that it is configured as a filament or planar plate structured under the wavelength of visible light, and in that said micro-structure (R) is a two-dimensional grating of absorbing material ( $k > 1$ ).

5        23. A method for constructing an emitter capable of being brought to incandescence by the passage of electric current, comprising the steps of:

        a) constructing a template of porous alumina,  
        b) infiltrating the template of porous alumina with  
10        a material destined to constitute the emitter (F), in such a way that the alumina structure serves as a mould for at least part of an anti-reflection micro-structure (R) of the emitter (F), said material (Au) having a melting temperature which is lower than the operating  
15        temperature at which the emitter (F) is destined to be used,

        c) depositing a refractory oxide (CR) onto the part of the emitter (F) destined to extend between two respective terminals (H), said oxide (OR) being  
20        operative to preserve a profile of said micro-structure (R) in case of deformation or change of state of the respective material (Au), consequent to the use of the emitter (F) at operating temperatures exceeding the melting temperature of said material (Au),  
25        wherein the template of porous alumina is maintained or else eliminated prior to step c).

        24. A method as claimed in claim 23, where the step a) comprises the deposition of an aluminium film, with thickness in the order of one micron, on a suitable  
30        substrate and the subsequent anodisation thereof, said anodisation comprising at least:

- a first phase of anodisation of the alumina film;
- a phase of reducing the irregular alumina film obtained as a result of the first anodisation phase;
- 35        - a second phase of anodisation of the alumina film

starting from the residual part of irregular alumina not eliminated by said reduction phase.

25. A method for constructing an emitter capable of being brought to incandescence by the passage of electric current, comprising the steps of:

5 - obtaining a filiform or laminar element of the material whereof the emitter is to be made (F), said material having a melting temperature lower than the operating temperature at which the emitter (F) is  
10 destined to be used;

- etching said element to form an anti-reflection micro-structure (R),

and coating the emitter (F) in which the anti-reflection micro-structure (R) has been formed with a refractory oxide (OR), said oxide (OR) being operative  
15 to preserve a profile of said micro-structure (R) in case of deformation or change of state of the respective material (Au), consequent to the use of the emitter (F) at operating temperatures exceeding the  
20 melting temperature of said material (Au).

26. An incandescent light source, comprising a light emitter capable of being brought to incandescence by the passage of electric current, characterised in that said emitter (F) is as claimed in one or more of  
25 the claims from 1 through 22.

27. A lighting device, in particular for motor vehicles, comprising one or more light sources (1) as claimed in claim 26.

28. A planar matrix of micro-sources of incandescent light, each comprising a respective  
30 emitter (F) as claimed in one or more of the claims 1 through 22.